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Stepanenko et al.

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[54] **LEAF SPRING STRAIGHTENING APPARATUS**

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[51] **Int. Cl.**[7] **B21D 7/02**; B21D 11/02

[52] **U.S. Cl.** **72/383**; 72/298; 72/387

[58] **Field of Search** 72/383, 386, 387, 72/388, 218, 298; 140/106, 147

[56] **References Cited**

U.S. PATENT DOCUMENTS

1,066,247	7/1913	Brown, Jr.	72/383
3,824,834	7/1974	Durham	72/387
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5,001,918	3/1991	Stepanenko et al.	72/133
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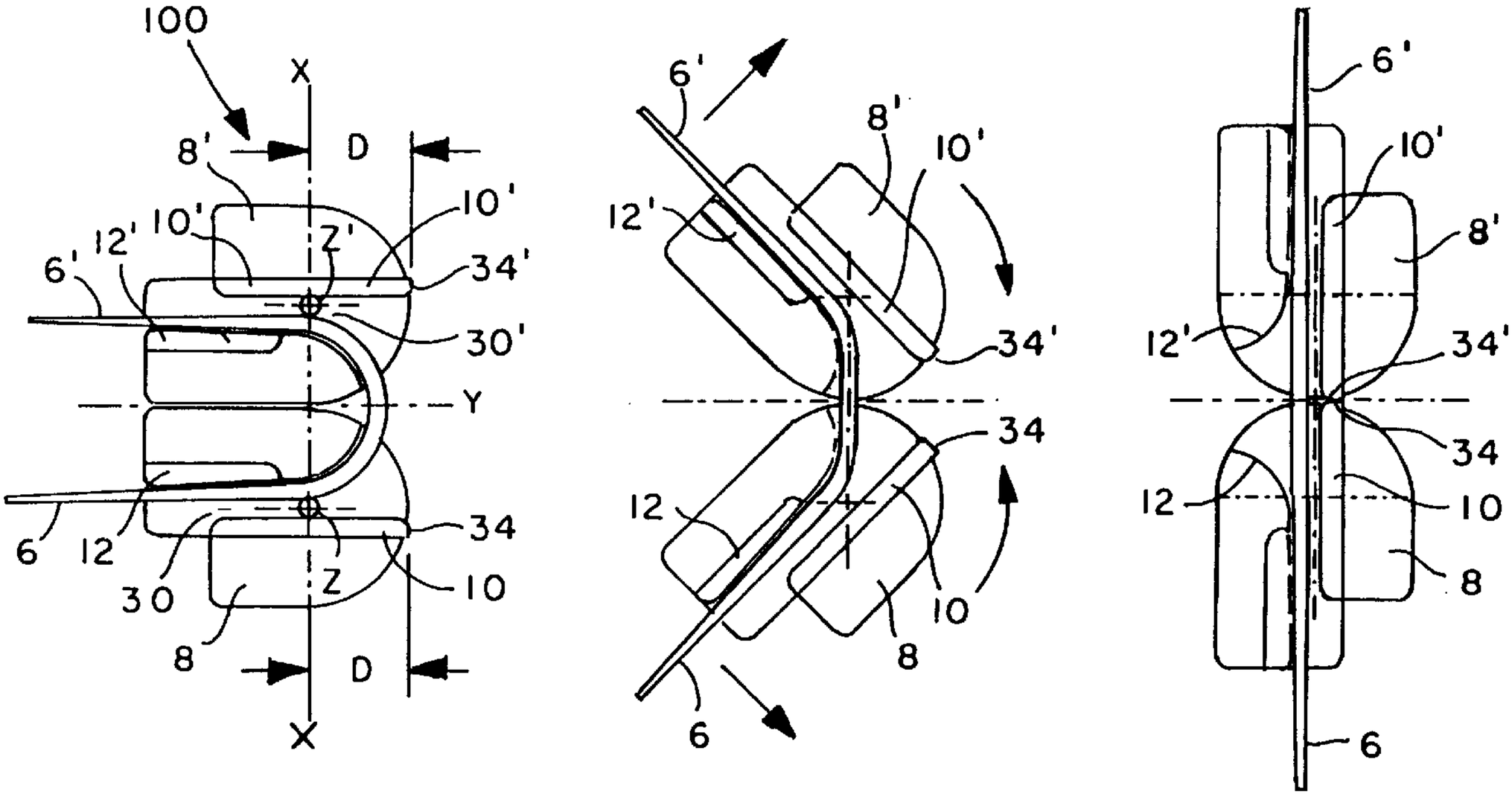
63-137518	6/1988	Japan	72/383

Primary Examiner—David Jones
Attorney, Agent, or Firm—Dykema Gossett PLLC

[57] **ABSTRACT**

Disclosed is a preferred embodiment of straightening apparatus (**100**) featuring a pair of adjacent rotary block members (**8**) and (**8'**) having channels (**30**) and (**30'**) respectively disposed therein for receiving spaced-apart legs (**6**) and (**6'**) of a heated leaf springs folded into a substantially flat "U" shaped configuration as block members (**8**) and (**8'**) are caused to rotate in unison in opposite directions, inner walls (**12**) and (**12'**) of channels (**30**) and (**30'**) respectively engage and urge legs (**6**) and (**6'**) away from each other whilst outer walls (**10**) and (**10'**) of channels (**30**) and (**30'**) respectively are operative to engage and provide support for substantially the entire length of a convex side (**26**) of a curved section (**24**) of the folded leg spring effective to prevent warpage thereof during the straightening process.

2 Claims, 3 Drawing Sheets



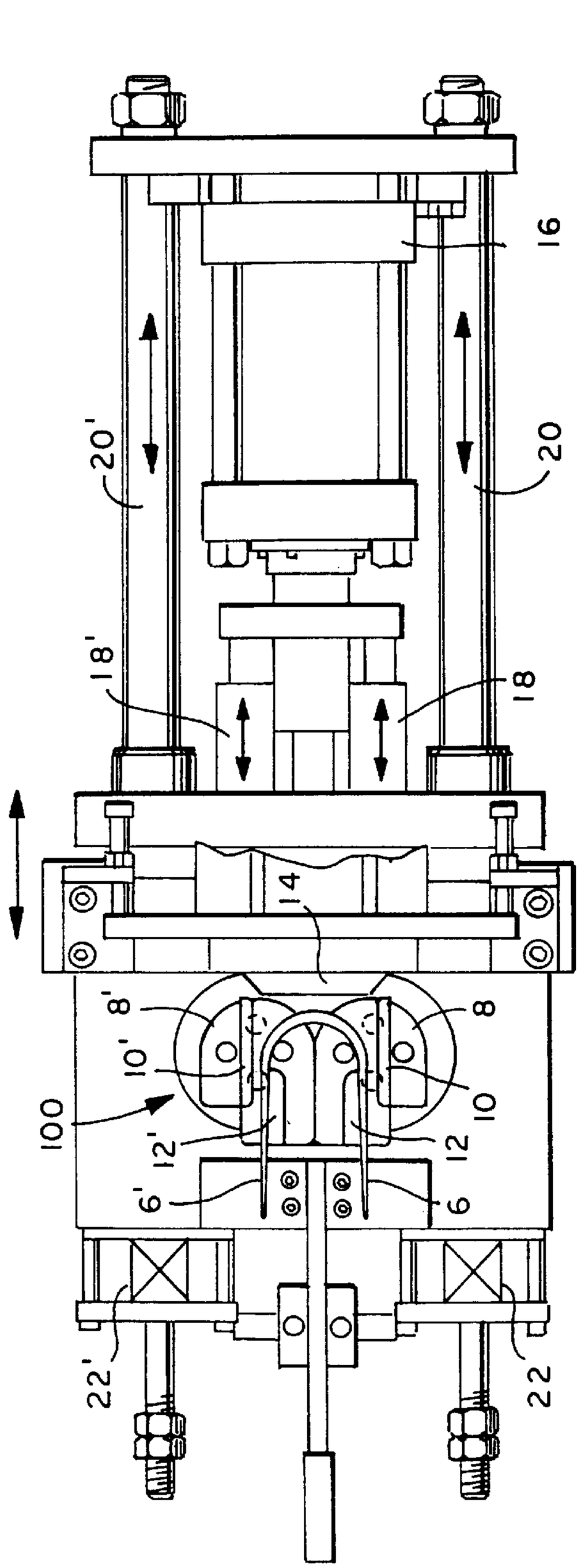


FIG. 1

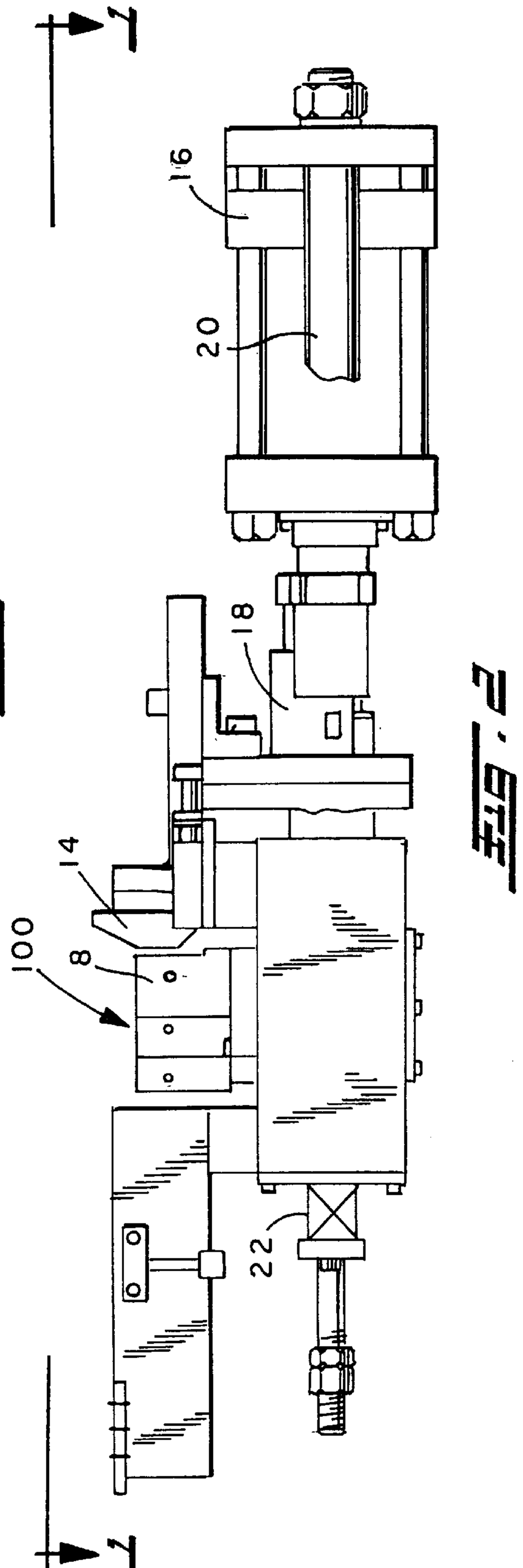


FIG. 2

FIG. 4C

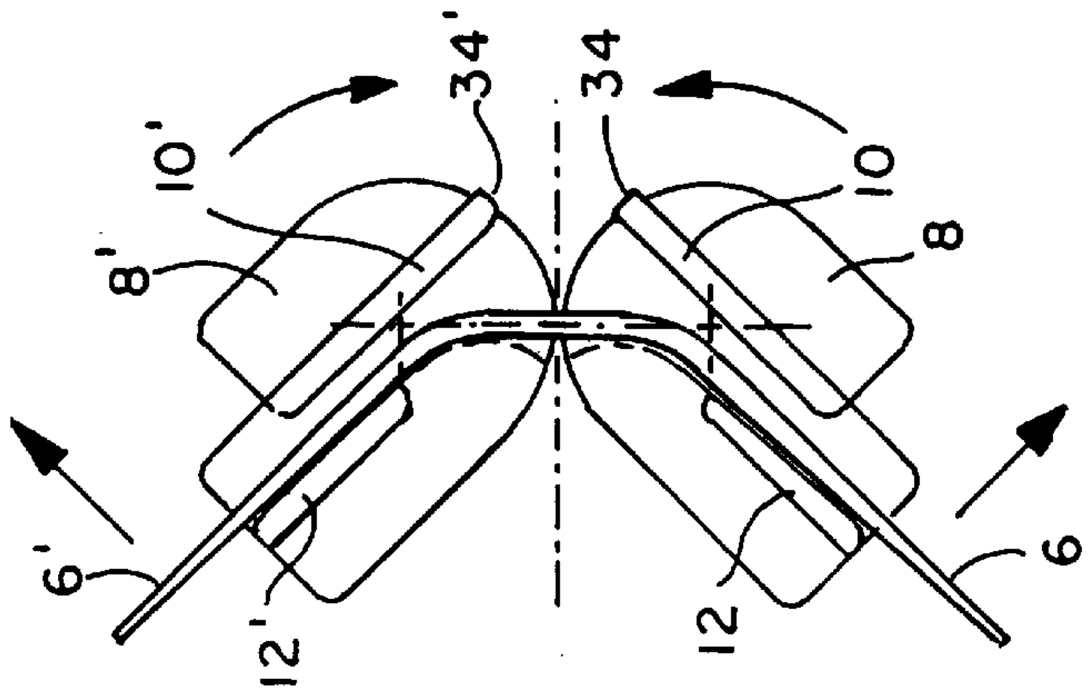


FIG. 4B

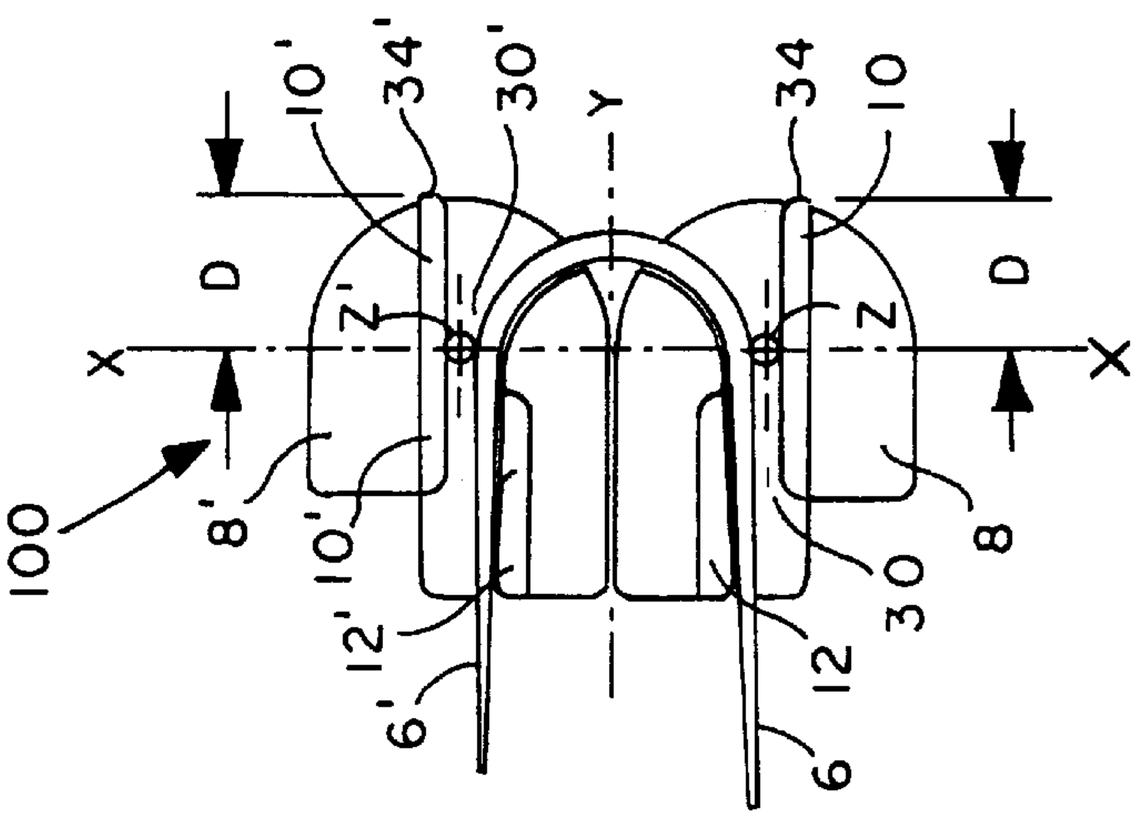


FIG. 4A

FIG. 5

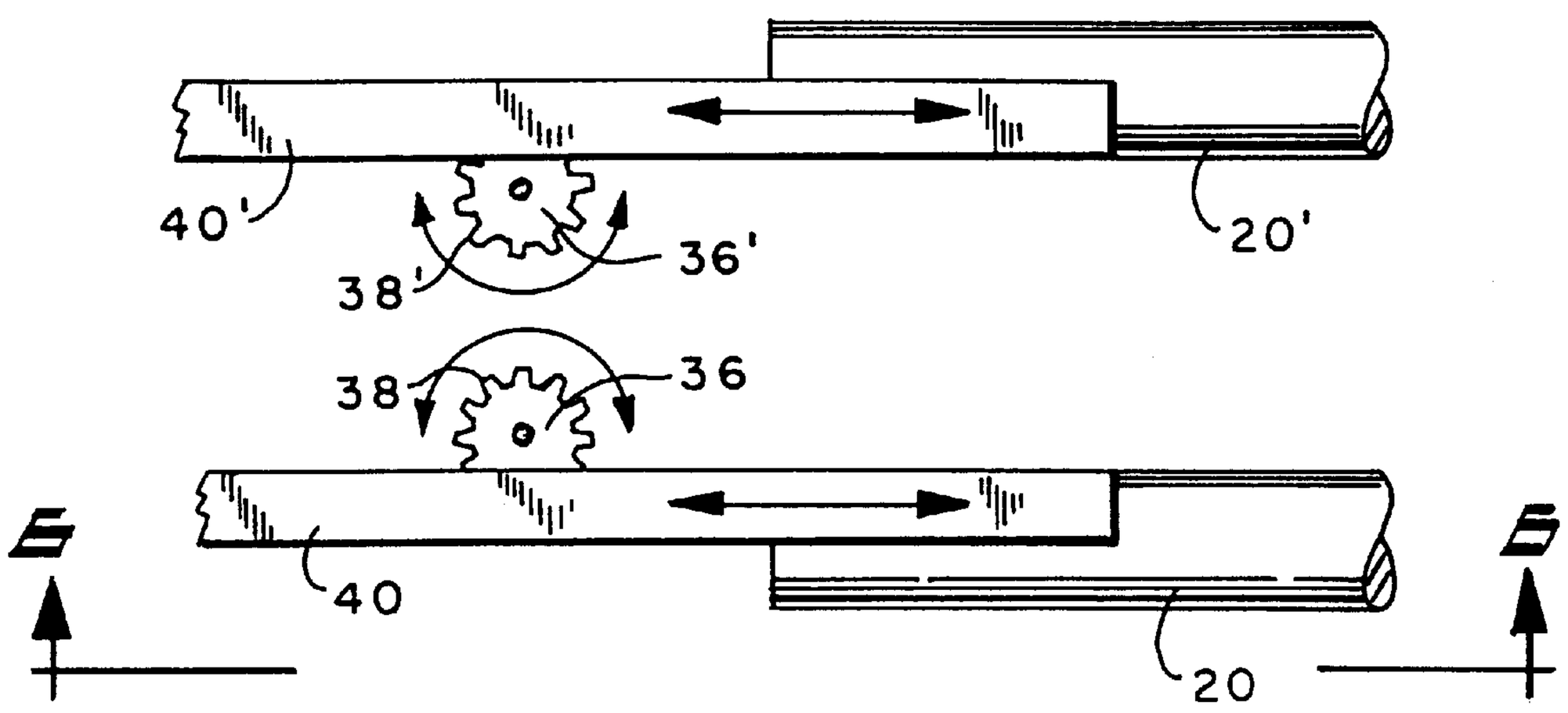


Fig. 5

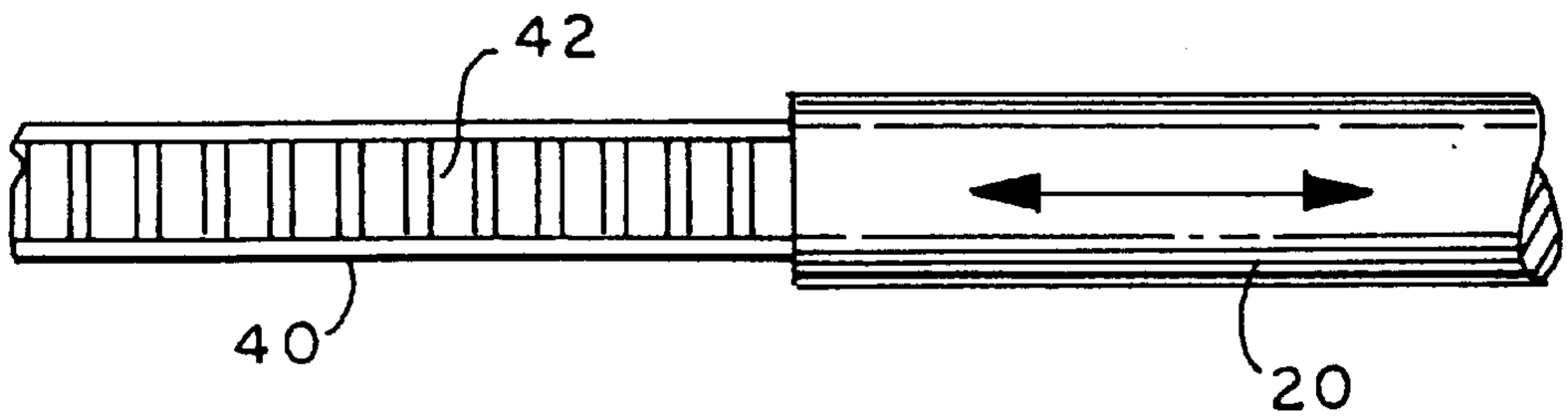


Fig. 6

LEAF SPRING STRAIGHTENING APPARATUS

INTRODUCTION

This invention relates generally to apparatus for straightening a folded heated leaf spring and more particularly to apparatus for straightening a heated leaf spring that has been folded into a substantially flat "U" shaped configuration during a process for simultaneously tapering opposite ends thereof.

CROSS-REFERENCE TO RELATED APPLICATIONS

Not Applicable

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable

MICROFICHE APPENDIX

Not Applicable

BACKGROUND OF THE INVENTION

Although not limited to the particular folding or bending processes disclosed in U.S. Pat. No. 5,001,918, the disclosure of which is incorporated herein by reference, the apparatus of the present invention is particularly applicable thereto as the processes disclosed therein relate to apparatus for simultaneously tapering opposite ends of a heated leaf spring during which the heated leaf spring is straightened after having been folded or bent into a substantially flat "U" shaped configuration of which the coinventors of the present invention are amongst the coinventors of U.S. Pat. No. 5,001,918.

The straightening apparatus of the present invention provides however an improvement over the straightening apparatus disclosed in U.S. Pat. No. 5,001,918 in that it is adapted to prevent warpage from occurring at the fold or curved section of the leaf spring during the straightening process.

BRIEF SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to provide apparatus for straightening a heated folded leaf spring.

It is another object of the invention to provide apparatus for straightening a heated leaf spring folded into a substantially flat "U" shaped configuration during a process for simultaneously tapering opposite ends thereof.

It is another object of the invention to provide apparatus operative to prevent warpage from occurring at a central curved section of a heated leaf bent or folded into a substantially flat "U" shaped configuration during a process for simultaneously tapering opposite ends thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top elevation view of a machine taken along view line **1—1** in FIG. **2** operating a preferred embodiment of apparatus for the invention referenced by numeral **100**;

FIG. **2** is a side elevation view of the machine of FIG. **1**;

FIG. **3** is a plan elevation view of a folded leaf spring prior to being straightened by apparatus **100**,

FIGS. **4**A–**4**C are schematic diagrams of the process by which apparatus **100** straightens a folded heated leaf spring;

FIG. **5** is a partial top elevation view of a preferred mechanism for rotating certain components of apparatus **100** in the form of a pair of racks (**40**, **40'**) and pinions (**36**, **36'**); and

FIG. **6** is a side elevation view of the mechanism of FIG. **5** taken along view line **6—6**.

DETAILED DESCRIPTION OF THE INVENTION

In FIG. **1**, apparatus **100** is mounted on a machine that includes a hydraulic cylinder **16**, a pair of spaced-apart shafts **20** and **20'**, a pair of nitrogen springs **18** and **18'**, and a pair of tension springs **22** and **22'** whose operation is described hereafter in greater detail.

Apparatus **100** is operative to straighten a heated folded leaf spring having a pair of spaced-apart legs **6** and **6'** best described with respect to FIG. **3** that is heated to a red state at a temperature of typically between about 1600F. and about 2200F.

Legs **6** and **6'** taper away from opposite ends of a curved section **24** having a convex side **26** and a concave side **28**.

Curved section **24** has a radius of curvature "r" whose origin "O" is located at the intersection of orthogonal axis "x" and "y" of which axis "y" bisects the space between legs **6** and **6'**.

Returning to FIG. **1**, cylinder **16** is operative to reciprocate shafts **20** and **20'** in opposite directions as shown by the arrows.

A carriage assembly (not referenced) carries a support ram **(14)** that reciprocates in unison with shafts **20** and **20'** and is cushioned therefrom by spaced-apart hydrogen springs **18** and **18'** whose function is to keep the heated folded spring tight in a tightly held position apparatus **100**.

Ram **14** is operative to engage the convex side of curved section **24** of the leaf spring to provide cushioned support there against during the straightening process.

A pair of tension springs **22** and **22'** as shown in FIGS. **1** and **2** are operative to urge shafts **20** and **20'** back towards the viewers right once the straightening process is complete and cylinder **16** enters into an exhaust stage.

The process by which the heated folded leaf spring is straightened as best shown in FIGS. **4**A–**4**C in which apparatus **100** is shown as having a pair of spaced-apart rotary block members **8** and **8'** having respective central rotational axis "z" and "z" that are orthogonal to the plane of axis "x" and "y" and are located on axis "x" respectively outwardly adjacent the sides of legs **6** and **6'** facing away from each other.

Block members **8** and **8'** are rotated in unison in opposite directions preferably by means of a rack and pinion arrangement such as shown in FIGS. **5** and **6** in which racks **40** and **40'** are secured to shafts **20** and **20'** respectively and reciprocate therewith and are respectively operative to rotate pinion gears **36** and **36'** by means of having spaced windows such as referenced by numeral **42** that meshingly engage the pinion gear teeth such as **38** and **38'** and cause them to rotate in opposite directions and which in turn are secured to and cause block member **8** and **8'** to rotate in opposite directions in unison therewith.

Block members **8** and **8'** respectively include channels **30** and **30'** therein that at the start of the straightening process are positioned to respectively receive legs **6** and **6'** at the folded heated leg spring thereon.

Channels **30** and **30'** have respective outer walls **10** and **10'** that extend beyond axis "X" for a distances "D" to free

ends **34** and **34'** such that the sum of both distances (2"D") is substantially the same as the length of the convex side **26** of curved section **24** of the folded heated leaf spring.

Channels **30** and **30'** include inner walls **12** and **12'** on the concave side of curved section **24** that extend for a prescribed distance towards axis "x" and thence turn angularly toward each other as best shown in FIGS. **4**A–**4**C such that they release from the concave side of curved section **24** during the straightening process.

In operations, the heated folded leaf spacing is dropped vertically onto blocks **8** and **8'** with its legs **6** and **6'** positioned in channels **30** and **30'** as previously described.

Actuation of cylinder **16** urges shafts **20** and **20'** (and racks **40** and **40'**) toward the viewers left in FIG. **1** which in turn causes pinion gear **36** to rotate counterclockwise in unison with pinion gear **36'** which is caused to rotate clockwise which in turn causes block members **8** and **8'** to rotate counterclockwise and clockwise respectively as shown by the arrows in FIG. **4**B.

The rotation of block members **8** and **8'** urge walls **12** and **12'** against legs **6** and **6'** respectively and spread them angularly away from each other as shown by the arrows in FIG. **4**B whilst free-ends **34** and **34'** of walls **10** and **10'** rotate towards each other until in close adjacent relationship with each other enabling walls **10** and **10'** to provide support against the outer convex side of curved section **24** as it becomes straightened during the straightening process which is further supplemented by ram **14** which holds walls **10** and **10'** against the convex side of curved section **24** when legs **6** and **6'** are in substantially alignment with each other after which the straightened leaf spring is removed from apparatus **100** for cooling and other additional operations that may be desired.

We claim:

1. An apparatus for straightening a U-shaped leaf spring wherein the spring includes a curved section having a concave side and a convex side and wherein the spring has a pair of elongated legs in spaced-apart relationship with each other from the curved section of the spring and the curved section of the spring has a radius of curvature adjacent a side of the legs facing away from each other, the apparatus comprising a plurality of pivotal block members which simultaneously rotate counter to one another, each of the blocks having a channel disposed thereon adapted to receive one of the leaf spring legs therein and the channel having an outer wall facing toward the other block outer wall which extends away from the curved section of the leaf spring to a respective free end such that the combined lengths of the outer walls on both blocks is substantially the same length of the convex side of the curved section of the leaf spring; each block channel having a respective inner wall facing away from the inner wall of the opposite block and facing a concave side of the leaf spring legs and adapted to engage and provide support to the concave curved section of the leaf spring during the straightening process; and a mechanism to rotate the blocks and straighten out the leaf spring.

2. The apparatus of claim **1** wherein the rotary block members are rotated simultaneously by a rack and pinion mechanism.

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